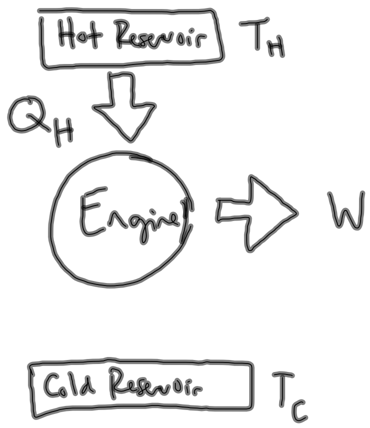
Heat Engine Notes 4.18.12 AP Physics

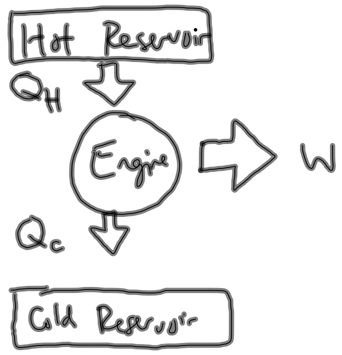
Heat Engines:

- Ideal:



  - $Q_H = W$
  - This can never happen.

- Actual:



- $W = |Q_H| - |Q_c|$
- Thermal efficiency:

$$e \equiv \frac{W}{|Q_H|} = \frac{|Q_H| - |Q_c|}{|Q_H|}$$

$$= 1 - \frac{|Q_c|}{|Q_H|}$$

An engine transfers 2.00E3 J of energy from a hot reservoir during a cycle and transfers 1.50E3 J as exhaust to a cold reservoir.
a) Find the efficiency of the engine.
b) How much work does this engine do in one cycle?

a) $$e = 1 - \frac{|Q_c|}{|Q_H|}$$

$$= 1 - \frac{1.5E3\,J}{2E3\,J}$$

$$= 0.25$$

b) $$W = |Q_H| - |Q_c|$$

$$= 2E3\,J - 1.5E3\,J$$

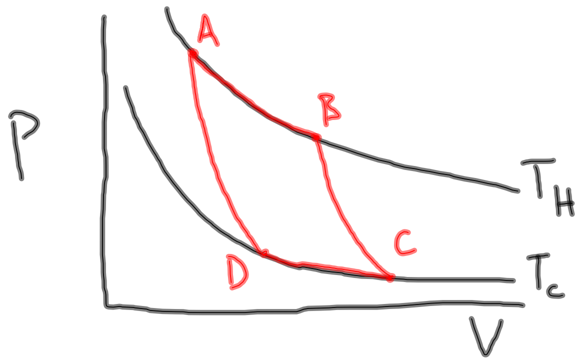
$$= 5E2\,J$$

Reversible v. Irreversible:

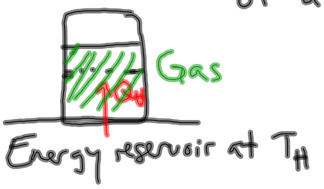
- Reversible process is one in which the system may return to its initial conditions along the same path in a PV diagram.
- Irreversible process is one where equilibrium is not maintained throughout the process. This is the state of all real processes.

Ideal, reversible cycle: Carnot cycle

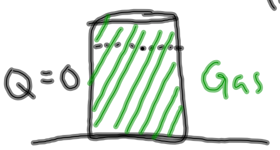
100% efficient



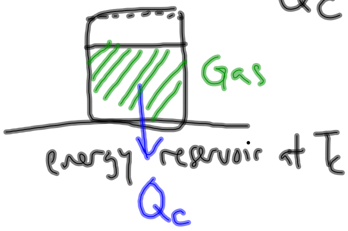
A → B isothermal expansion of a gas



B → C adiabatic expansion (no heat coming into system)



C → D isothermal compression
Q_c (heat leaving)



D → A adiabatic compression